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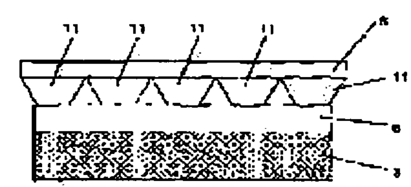
(54) LUMINESCENT ELEMENT

(57)Abstract:
PROBLEM TO BE SOLVED: To provide an electroluminescent element with improved emission efficiency.
SOLUTION: With an electroluminescent element equipped with electrodes and a luminescent layer, at least one of the electrodes is a transparent electrode, which a mesa-shaped fine structural body having a plurality of mesa-shaped transparent bodies is arranged opposite to the side the transparent electrodes face the luminescent layer, with the shorter side of the mesa-shaped fine structural body toward it.



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LEGAL STATUS

[Date of request for examination]

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CLAIMS

[Claim(s)]
[Claim 1] Electroluminescence equipment characterized by what the shorter side side of this mesa configuration fine structure object has been arranged for as the nearer one to the opposite side which faces this luminous layer of this transparent electrode in the mesa configuration fine structure object which has two or more mesa configurations which at least one of these the electrodes is a transparent electrode, and consist of the transparent body in electroluminescence devices equipped with the electrode and the luminous layer.
[Claim 2] Electroluminescence equipment according to claim 1 characterized by unifying the closure object for operating said luminous layer to stability in atmospheric air, and said mesa configuration fine structure object.
[Claim 3] Electroluminescence equipment according to claim 1 or 2 characterized by preparing a reflector in the taper section of said mesa configuration fine structure object.
[Claim 4] Electroluminescence equipment according to claim 1 to 3 characterized by forming an electrode only in the part by which said two or more mesa configuration fine structure objects are arranged.

[Translation done.]

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2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to spontaneous light type luminescence equipment like an electroluminescence (EL) component.
[0002]
[Description of the Prior Art] An electronic display is roughly divided by the usage of a beam of light, and there are two kinds. The controlling element itself in which one forms equipment is the light-receiving mold display which operates as the so-called shutter which does not emit light, and penetrates and intercepts outdoor daylight, and constitutes a display. Other one is a spontaneous light type display which equipment itself emits light and a user is made to recognize as brightness.
[0003] As a light-receiving mold display, the liquid crystal display (LCD) is known well, and it has spread widely now. There are organic electroluminescence (electroluminescence) including the cold cathode tube (CRT) which has spread most as a spontaneous light type display now, inorganic [EL], a plasma display panel (PDP), a light emitting diode display (LED), a fluorescent indicator tube display (VFD), a field emission display (FED), etc., utilization starts and, as for the part, development is actively performed for other things. Since the light-receiving mold indicating equipment represented by LCD needs the light source, generally a back light is required, a back light will always light up irrespective of the aspect of display information, and the power which is not mostly different from all display conditions will be consumed.
[0004] On the other hand, since only a part with the need of switching on the light according to display information only consumes power, a spontaneous light type display has theoretically the advantage that there is little power consumption as compared with a light-receiving mold display.
[0005] Moreover, although its so-called angle-of-visibility dependency which changes a display condition a lot according to the direction to observe is strong since LCD which is the representation of a light-receiving mold display uses the polarization control by the birefringence of liquid crystal, it does not almost have this problem at a spontaneous light display. Furthermore, in order that LCD may use the molecular orientation change originating in the dielectric anisotropy of the liquid crystal which is the organic elastic matter, the response time to an electrical signal is 1ms or more theoretically.
[0006] On the other hand, since the so-called carrier transition, such as an electron/electron hole, electron emission, plasma discharge, etc. are use with the above-mentioned technique in which development is further as a spontaneous light display, it is ns digit, and the response time is so high-speed that it does not become as compared with liquid crystal, and does not have the problem of the animation after-image originating in the lateness of a response of LCD.
[0007]
[Problem(s) to be Solved by the Invention] Thus, although it is a spontaneous light display with many advantages, current and being put in practical use completely are only CRT and LCD is still in use [the thing] as a flat-surface display considered that need will be extended increasingly from now on. The lowness of that luminous efficiency is one of this big cause. Although LCD must make a back light always turn on, so to speak, a back light is mere lighting, the luminous efficiency, brightness, a life, etc. are the techniques completed in every property, and there is almost no problem in stability practically [continuing shining efficiently] for a long time.
[0008] On the other hand, the actual condition is that the fundamental property of continuing shining efficiently to long duration stability in the above-mentioned spontaneous light type indicating equipment has not reached practical level. In order to raise luminous efficiency stably, development of luminescent

material is performed in all techniques, but since the three primary colors of R, G, and B need to solve this problem in a full color display, solution is not easy.

[0009] For this reason, the technique which improves luminous efficiency without being dependent on luminescent material is needed. In especially EL equipment, the problem which deactivates without carrying out total reflection of the luminescence from photogene by the interface with the substrate and atmospheric air which constitute equipment, and many of luminescence arriving at the equipment exterior is large.

[0010] Drawing 10 is the block diagram of conventional EL equipment 1. In drawing 10 , on the transparence substrate 2 in which the transparent electrode 5 was formed, carry out the laminating of a luminous layer 3 and the counterelectrode 4, form them, a luminous layer 3 is made to emit light by impressing electric field between an electrode 5 and 4, and light 8 is taken out through a transparent electrode 5 and the transparence substrate 2. If a counterelectrode 4 does not have the need for double-sided luminescence, in order to raise the brightness of luminescence 8, a reflexible metal electrode will usually be used in many cases. A luminous layer 3 having low moisture resistance generally, and touching atmospheric air regardless of organic electroluminescence and inorganic [EL], since the luminescence life is very short, it is necessary to isolate from atmospheric air with the closure object 6 and adhesives 7.

[0011] The explanatory view of the luminescence beam-of-light path of the conventional EL equipment 1 shown in drawing 11 at drawing 10 is shown. The sign same at drawing 11 as drawing 10 shows the same thing as drawing 10 , respectively. The luminescence beam of light of conventional EL equipment spreads the inside of each film, as shown in drawing 11 . Generally the refractive index of the ingredient of a luminous layer 3 is before and after 1.6, and the glass of about 1.8 refractive index and a substrate 2 of ITO typical as a transparent electrode 5 is about 1.5. The beam of light 8 which emitted light does not start total reflection from this relation to the luminous layer 3 by the interface with a transparent electrode 5, and an invasion include angle is conversely used as an acute angle. However, in the interface of the glass of a transparent electrode 5 and the transparence substrate 2, while a part is shut up by total reflection in a transparent electrode 5 and spreads the inside of a transparent electrode 5, it deactivates. Furthermore, some beams of light deactivate by total reflection similarly in the glass of a substrate 2, and an atmospheric interface. With the conventional EL equipment 1 of drawing 10 , there is internal deactivation by such total reflection about 80% of all luminescence ****, and almost all luminescence is not used effectively.

[0012] as the approach of solving the problem of this total reflection conventionally -- [OPTICS LETTERS/Vol.22 and No.6/March [ ] -- using the substrate of a mesa (trapezoid) configuration for 15, 1997, and p396-398] by G.Gu etc. is proposed. They make the mesa structure at the base of-like [square] with height of 2.2mm, a die length [of a base / of 3mm], and an include angle [of a slant face] of 34 degrees to a glass substrate, produce the organic EL device of the diameter of 0.5mm on the top face, and are investigating the effectiveness.

[0013] The explanatory view of the propagation path of the luminescence beam of light at the time of using the mesa structure for drawing 9 is shown. In drawing 9 , 9 shows the mesa structure. Moreover, in drawing 9 , in 3, a luminous layer and 5 show a transparent electrode and 8 shows a beam of light, respectively. After the most spreads the inside of the mesa structure 9, shortly, the beam of light which carried out total reflection of the beam of light 8 generated from the luminous layer 3 by the interface of the mesa structure 9 and atmospheric air although the part deactivated by total reflection in the interface of a transparent electrode 5 and the mesa structure 9 changes an include angle by the total reflection in the slant face, and is emitted into atmospheric air. In consideration of the damping coefficient of the quality of the material which forms the mesa structure 9 etc., the beam of light which carries out internal deactivation by producing suitably the height, width of face, and the include angle of a slant face can be decreased conventionally more sharply than structure, and luminous efficiency can be improved. G. Gu etc. is making the mesa structure 9 from the quality of the material of a high refractive index rather than the transparent electrodes 5, such as TiO_2, also prevents the total reflection in the interface of a transparent electrode 5 and the mesa structure 9, and is presupposing again that luminous efficiency can be improved more nearly further than the case where the mesa structure 9 is made with glass.

[0014] However, it is in ** to have prepared the mesa structure in 1 pixel which constitutes a display at one rate from the magnitude of the component which G.Gu etc. has reported. Thus, in the big mesa structure, the interior of the mesa structure is spread, before being followed and attached to a slant face, a beam of light declines and sufficient effectiveness is not acquired. Moreover, in producing a light emitting device from from [after making the mesa structure on a substrate], it becomes difficult to form a drive circuit and an electrode on a substrate. The active-matrix drive display which needs a complicated and detailed drive circuit especially is unproducible.

[0015] Furthermore, in order to form an electrode and a luminous layer only in the top face of the mesa structure like G.Gu, it is difficult to have to use approaches, such as mask vacuum evaporationo, and to make a large-sized and high definition display. Conversely, even if a substrate configuration is disregarded and it forms an electrode and a luminous layer in the whole surface as usual, it is difficult for the effect of the unevenness by the projection of the mesa structure etc. to occur, and to make a uniform display.
[0016] Anyway, although the report of G.Gu etc. has effectiveness as a fundamental experiment, it has left many problems for actually industrializing. Moreover, although it is not the mesa structure, the taper-like component which is going to take out effectively the beam of light which had deactivated by total reflection conventionally similarly is reported to JP,10-189243,A. However, the structure of this publication number No. 189243 [ten to] is difficult to acquire effectiveness as a beam of light needs to jump over the trough of the taper section, and it is based on the quite complicated principle so that it may be shown in drawing 6 of this Japanese-Patent-Application-No. No. 189243 [ten to] official report, and explained by this official report. Moreover, it will become a defect, if the whole taper section cannot be covered in order to form an electrode and a luminous layer in the taper section. G. It must be said that the approach of combining with approaches, such as Gu, preparing the configuration which is not a certain flatness in a substrate, and forming an electrode and a luminous layer has a big problem in actual effectiveness and dependability.
[0017] Thus, there was no luminescent-material dependency, and although it was the effective taper structure which raises the luminous efficiency of a spontaneous light type display theoretically, there was no method of acquiring sufficient effectiveness and dependability in fact to this.
[0018]
[Means for Solving the Problem] In order to solve the above-mentioned problem, in this application, the shorter side side is arranged for two or more transparence mesa configuration fine structure objects as a direction near a transparent electrode to a luminous layer [of the transparent electrode in the pixel which constitutes a display], and opposite side. G. Like Gu, the one mesa structure can be made small by arranging two or more fine structure objects not to 1-pixel the 1 structure but to 1 pixel, and the problem of attenuation by internal propagation can be solved.
[0019] Furthermore, with a substrate, a transparent electrode makes a transparent electrode the final train which a beam of light passes as structure formed in the opposite side to a luminous layer. Without performing processing special to a substrate by carrying out the closure, as much transparence mesa configuration fine structure objects are formed in the closure object which intercepts a component from atmospheric air and these and a transparent electrode are contacted, light-emitting parts, such as an electrode and a luminous layer, can be formed evenly as usual, and can raise luminous efficiency sharply only by processing it into a closure object.
[0020]
[Embodiment of the Invention] The mode of 1 operation of this invention is explained based on drawing. Drawing 1 shows the block diagram of the mode of operation of the first of this invention. By drawing 1 , electroluminescence equipment 10 is formed in a substrate 2 in order of an electrode 4, a luminous layer 3, and a transparent electrode 5, and is produced to it. said electrode 4 -- transparence -- even when -- although it may not be transparent, said transparent electrode 5 is transparent and is made into the structure which takes out luminescence outside through this. Although the closure object 6 is finally installed for dependability, naturally the closure object 6 is transparent, in order to take out luminescence. For example, glass, plastics, transparence resin, etc. can be used.
[0021] The enlarged drawing which expanded said luminous layer 3, the transparent electrode 5, and the closure object 6 of a gestalt of implementation of the above first to drawing 2 is shown. Much transparent mesa configuration fine structure objects 11 which are one of the descriptions of this invention are formed in the front face of the closure object 6. Etching and laser processing can perform this comparatively easily. By closing with the closure object 6 so that a transparent electrode 5 and the mesa configuration fine structure object 11 may touch, electroluminescence equipment 10 can raise luminous efficiency by the principle of drawing 9 in the conventional state. Since the a large number configuration of each mesa structure is carried out minutely unlike G.Gu etc., the mesa structure (namely, mesa configuration fine structure object 11) of this invention can disregard the effect of attenuation.
[0022] Drawing 3 shows the block diagram of the mode of operation of the second of this invention. The gestalt of this second operation is characterized by the point of having formed the reflector 12 in the slant face (taper section) of the mesa configuration fine structure object 11, respectively, as compared with the gestalt of operation of the first of drawing 1 . Here, the sign same at drawing 3 as drawing 1 shows the respectively same thing as drawing 1 . Thus, effectiveness improves further by forming a reflector 12 in the

slant face of the mesa configuration fine structure object 11. That is, as shown in a detail, all beams of light can be emitted to drawing 4 into atmospheric air from the mesa configuration fine structure object 11 by the reflector 12.
[0023] Drawing 5 shows the block diagram of the mode of operation of the third of this invention. The gestalt of this third operation has the description in the point of having stuck optically between a transparent electrode 5 and the mesa configuration fine structure objects 11 with matter, such as matching oil 13, as compared with the gestalt of operation of the first of drawing 1 . Here, the sign same at drawing 5 as drawing 1 shows the respectively same thing as drawing 1 . Like the gestalt of the third operation, if between a transparent electrode 5 and the mesa configuration fine structure objects 11 is optically stuck with matter, such as matching oil 13, the luminous efficiency of equipment can be improved more effectively.
[0024] Drawing 6 shows the block diagram of the mode of operation of the fourth of this invention. The gestalt of this fourth operation has the description in the point in which the electrode which counters so that electric field may be impressed only to the part which arranges the mesa configuration fine structure object 11 as compared with the gestalt of operation of the first of drawing 1 was formed. Here, the sign same at drawing 6 as drawing 1 shows the respectively same thing as drawing 1 . Since the electrode 5 which counters so that electric field may be impressed only to the part which arranges the mesa configuration fine structure object 11 like the gestalt of this fourth operation was formed, power consumption of the part without the mesa configuration fine structure object 11 is not carried out, but its luminous efficiency improves more.
[0025] Much mesa configuration fine structure objects 11 of the gestalt of these firsts thru/or the fourth operation can be carried out like drawing 7 , and can be made. Drawing 7 shows the explanatory view of the creation process of the mesa configuration fine structure object 11. A resist 14 and the resist patternized in exposure by the photo mask 15 of a predetermined configuration and development are formed on the closure object 6. the closure object 6 is etched and fluoric acid etc. if it is glass -- produces the mesa configuration fine structure object 11. Usually, by etching using a resist, since it becomes a taper cross section, a mesa configuration (width of face Du and Db, height h, an include angle theta) is easily controllable by controlling etching conditions (etchant, time amount, temperature, flow of etchant, etc.). What is necessary is just to form it by vacuum evaporationo, plating, etc., before a reflector 12 carries out resist exfoliation of the silicon metallurgy group etc. If a resist is exfoliated, the mesa configuration fine structure object 11 will be completed. In addition, laser processing can also be used instead of etching. It is better to form densely like [in drawing 7 , it is dispersed and the mesa configuration fine structure object 11 is illustrated so that intelligibly, but / in order to acquire effectiveness to max] drawing 2 , and 3 and 5.
[0026] Furthermore, a thing with a polygonal base is sufficient also as a thing with a circular base as shown in drawing 8 as a mesa configuration fine structure object 11. Here, in the organic EL device which makes a fluorescent substance absorb luminescence from a light emitting device to JP,11-329726,A, and makes it emit light, the reflective film is prepared in the fluorescent substance side face. However, the total reflection which is a big problem for luminous efficiency is not necessarily controlled only by collecting the scattered lights by the fluorescent substance ahead with the reflective film. therefore -- the effectiveness of the improvement in luminous efficiency -- this application -- it should also reach -- there is nothing. Moreover, it is 1-pixel one structure clearly like G.Gu etc., and the direction of attenuation of the light which spreads the inside of a fluorescent substance rather than the effectiveness by the reflective film will become large.
[0027]
[Example] Based on an example, the invention in this application is explained further in detail.
[0028]
[Example 1] As an example of this invention, the electroluminescence equipment 10 shown in drawing 1 was produced as follows. The laminating of the ITO was carried out on the substrate 2 as what carried out Mg/aluminum as a reflector 4 (namely, electrode 4), and carried out the laminating of electron hole transportation layer alpha-NPD to the luminescence organic material Alq3 as a luminous layer 3, and a transparent electrode 5. It considered as the order of a laminating which electron hole transportation layer alpha-NPD and ITO touch. All of these production were performed where atmospheric air is intercepted. Thickness of a luminous layer was made into Alq3 (2000A) and alpha-NPD (1000A). The transparent body which, on the other hand, formed much mesa configuration fine structure objects 11 of a detailed taper configuration as shown in drawing 2 as a closure object 6 was prepared. According to the approach of drawing 7 , patterning of glass or a transparent plastic, and the transparence resin was carried out, and the taper configuration was formed. A base is one-side the round shape it is [round shape] the square or diameter of 20 micrometers it is [diameter] 20 micrometers, and height set the taper configuration to 17

micrometers. It covered and the above-mentioned closure object 6 was put so that the shorter side side of a taper configuration might touch a transparent electrode 5, and it fixed to the substrate 2 by the sealing compound 7, and electroluminescence equipment was produced. When the direct-current electric field of 7V were impressed by making a transparent electrode 5 into straight polarity, having made the reflector 4 as negative polarity, luminescence of brightness 500 cd/m2 was able to be checked by 2 the current density of 0.2mA/mm.

[0029]

[The example 1-1 of a comparison] The usual electroluminescence equipment which does not prepare a taper configuration in the closure object 6 of this example 1 as an example of a comparison was produced similarly. When the direct-current electric field of 7V were impressed by making a transparent electrode into straight polarity, having made the reflector as negative polarity, only luminescence of 120 cd/m2 was able to check brightness by 2 the current density of 0.2mA/mm.

[0030]

[The example 1-2 of a comparison] The conventional electroluminescence equipment of drawing 10 was similarly produced as an example of a comparison. When the direct-current electric field of 7V were impressed by making a transparent electrode 5 into straight polarity, having made the reflector 4 as negative polarity, only luminescence of 120 cd/m2 was able to check brightness by 2 the current density of 0.2mA/mm. The display of high brightness was producible 4 or more times with the same power with this invention. In this case, luminescent material, no electrode material, etc. were changed, but the effectiveness which takes out the luminescence capacity which luminescent material originally has to the exterior required as a display was only raised, and dependability, such as a life, does not fall at all.

[0031]

[Example 2] As the second example of this invention, the electroluminescence equipment 10 shown in drawing 1 was produced as follows. The laminating of the ITO was carried out on the substrate 2 as what carried out Mg/aluminum as a reflector 4 (namely, electrode 4), and carried out the laminating of electron hole transportation layer alpha-NPD to the luminescence organic material Alq3 as a luminous layer 3, and a transparent electrode 5. It considered as the order of a laminating which electron hole transportation layer alpha-NPD and ITO touch. All of these production were performed where atmospheric air is intercepted. Thickness of a luminous layer was made into Alq3 (2000A) and alpha-NPD (1000A). The transparent body in which much mesa configuration fine structure objects 11 of the detailed taper configuration which formed the reflector 12 in the slant face as shown in drawing 3 as a closure object 6 on the other hand were formed was prepared. According to the approach of drawing 7 , patterning and a reflector were formed for glass or a transparent plastic, and transparence resin, and the taper configuration was formed. A base is one-side the round shape it is [round shape] the square or diameter of 20 micrometers it is [diameter] 20 micrometers, and height set the taper configuration to 17 micrometers. It covered and the above-mentioned closure object 6 was put so that the shorter side side of a taper configuration might touch a transparent electrode 5, and it fixed to the substrate 2 by the sealing compound 7, and electroluminescence equipment was produced. When the direct-current electric field of 7V were impressed by making a transparent electrode 5 into straight polarity, having made the reflector 4 as negative polarity, luminescence of brightness 600 cd/m2 was able to be checked by 2 the current density of 0.2mA/mm.

[0032]

[The example 2-1 of a comparison] The usual electroluminescence devices which do not prepare a taper configuration in the closure object 6 of an example 1 as an example of a comparison were produced similarly. When the direct-current electric field of 7V were impressed by making a transparent electrode 5 into straight polarity, having made the reflector 4 as negative polarity, only luminescence of 120 cd/m2 was able to check brightness by 2 the current density of 0.2mA/mm.

[0033]

[The example 2-2 of a comparison] The conventional electroluminescence equipment of drawing 10 was similarly produced as an example of a comparison. When the direct-current electric field of 7V were impressed by making a transparent electrode 5 into straight polarity, having made the reflector 4 as negative polarity, only luminescence of 120 cd/m2 was able to check brightness by 2 the current density of 0.2mA/mm. The display of high brightness was producible 5 or more times with the same power with this invention. In this case, luminescent material, no electrode material, etc. were changed, but the effectiveness which takes out the luminescence capacity which luminescent material originally has to the exterior required as a display was only raised, and dependability, such as a life, does not fall at all. As mentioned above, although the example of this invention was explained, this invention is not limited to this.

[0034]
[Effect of the Invention] By being with this invention, the luminous efficiency of a spontaneous light type display can be raised sharply. and -- the case where a production process does not become complicated, either, but manufacture effectiveness is good, and a complicated drive and a complicated electrode are further formed on a substrate -- a failure -- **** and a active-matrix drive display -- it can create -- obtaining -- obtaining -- ** Furthermore, luminescent material, an electrode material, etc. did not need to be changed, the effectiveness which takes out the luminescence capacity which luminescent material originally has to the exterior required as a display was only raised, and dependability, such as a life, has the effectiveness which was [fall / at all] excellent.

[Translation done.]

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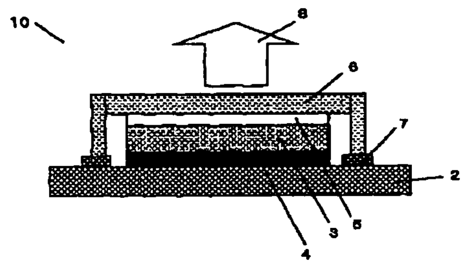
DRAWINGS

[Drawing 1]



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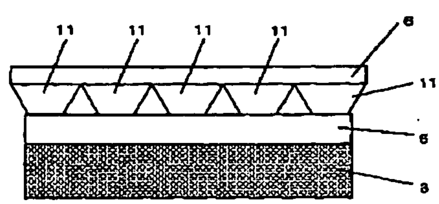
[Drawing 2]



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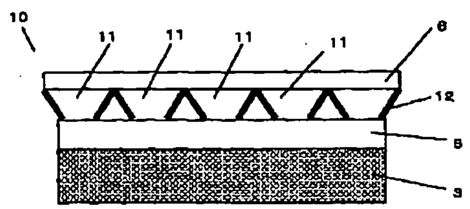
[Drawing 3]



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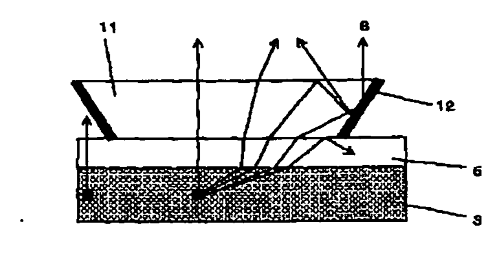
[Drawing 4]



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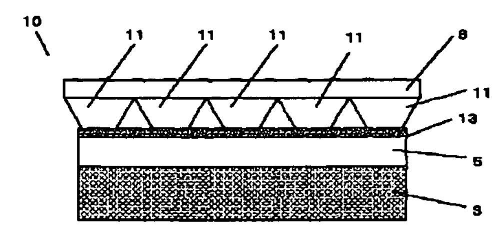
[Drawing 5]



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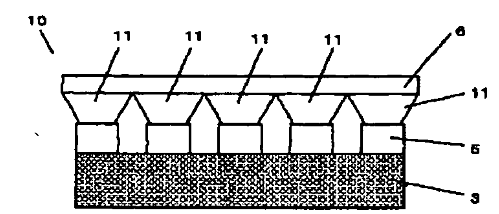
[Drawing 6]



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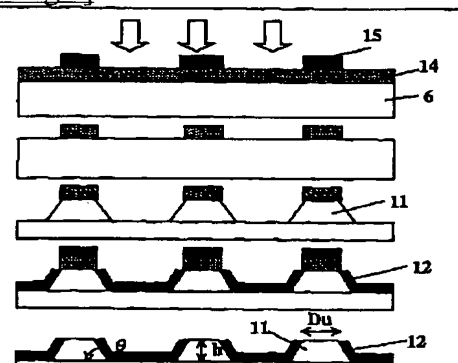
[Drawing 7]



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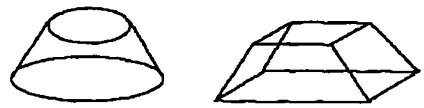
[Drawing 8]



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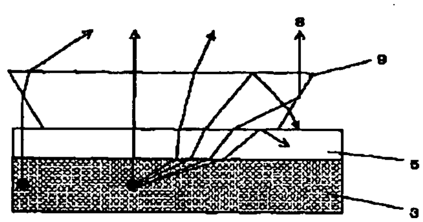
[Drawing 9]



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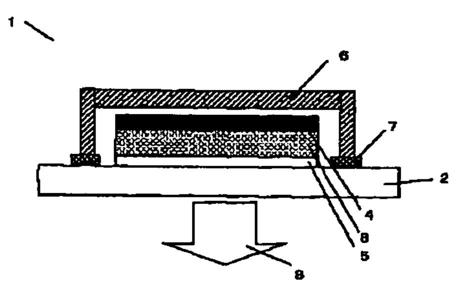
[Drawing 10]



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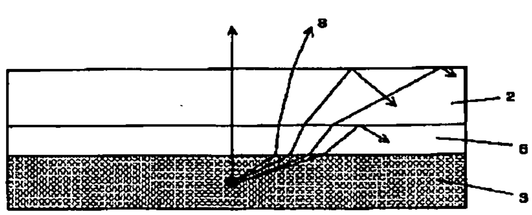
[Drawing 11]



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